

Original Investigation

Newly Designed Upper Lateral Cartilage Flap for Preventing Depression of the Keystone Area in Large-Nose Septorhinoplasty

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IMPORTANCE Because large dorsal reduction may weaken the keystone area, later notching of this area should be prevented while reducing large humps during septorhinoplasty.

OBJECTIVE To determine whether a triangular-shaped flap of upper lateral cartilages (ULCs) that we designed can prevent secondary deformity of the nasal dorsum in the keystone area following large hump reduction.

DESIGN, SETTING, AND PARTICIPANTS In this retrospective study, medical records as well as preoperative and postoperative photographs of septorhinoplasty cases in which triangular flaps had been used between April 1, 2012, and March 3, 2013, were reviewed. Data analysis was conducted from March 3 to May 10, 2014. Demographic data, amount of hump reduction, and any irregularity of the dorsum in the keystone area mentioned in the medical record or identified in postoperative profile view photographs were assessed. The study was conducted in a research center, and the operations were performed in a private setting. Patients had been scheduled for septorhinoplasty with flap reconstruction if more than 3 mm of dorsal hump reduction was planned and their skin was not thin. Of 41 identified patients, 3 could not be monitored for 1 year; 38 patients were included in the analysis.

EXPOSURES Open septorhinoplasty had been performed, and more than 3 mm of dorsum had been removed in all patients whose data were analyzed. During stepwise resection of the nasal dorsum, a triangular-shaped remnant of the most cephalomedial part of the ULC was maintained intact on each side over the keystone area.

MAIN OUTCOMES AND MEASURES Irregularity of the nasal dorsum over the keystone area in postoperative profile view photographs.

RESULTS More than 3 mm of hump reduction had been made in all 38 patients. No irregularities were observed in the postoperative photographs or had been found on digital examination of the keystone area after at least 12 months of follow-up.

CONCLUSION AND RELEVANCE Maintaining a remnant of the ULC over the keystone area in the form of a triangular-shaped flap on each side is a simple, reliable, and durable way to prevent notching of the keystone area during lowering of the nasal dorsum in large noses with sufficient skin thickness.

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It is not easy to ensure a straight, smooth dorsum several months, let alone years, after septorhinoplasty. The outcome becomes a matter of dissatisfaction, especially if a straight, smooth dorsum was the only request of the patient or if he or she notices a notch in the rhinion due to anatomic deformities in the keystone area after the operation.¹ The problem is more common in large noses when a considerable amount of dorsal hump removal is necessary. The depression may become visible as edema resolves at 3 to 12 months,² and patients with thin skin are at a higher risk for this problem.³

Considering that the dorsal irregularities of the rhinion are due to keystone area abnormalities, which is a common problem in secondary rhinoplasty, many surgical techniques have been introduced to correct such iatrogenic deformities. A variety of autologous or synthetic materials have been used to camouflage such dorsal irregularities.⁴

However, prevention is preferable to correction, and this objective usually focuses on preventing irregularities following hump resection in the keystone area in primary septorhinoplasty. One option is the use of onlay grafts to camouflage irregularities that may become apparent later during the healing process.⁵ Another option is the use of inlay grafts (spreader grafts) to stabilize the reduced dorsum and prevent unpredictable results in the middle vault, especially the inverted-V deformity. An intimate knowledge of anatomy of the keystone area has led to a variety of surgical techniques proposed to create a smooth dorsum in septorhinoplasty. Different authors have suggested meticulous reduction of the upper lateral cartilages (ULCs) with component dorsal reduction,⁶ use of ULC flaps,⁷ special suturing techniques of the ULCs,⁵ or even keeping the ULCs intact while reducing the nasal septum.¹ In keeping with this last concept that “prevention is the best medicine,” we describe and evaluate our approach for preventing keystone area notching after hump removal in primary septorhinoplasty in large noses.

Methods

Patient Population

A retrospective review of medical records on patients who underwent primary septorhinoplasty in the private clinic of one of us (M.S.) was performed between April 1, 2012, and March 3, 2013. Patients in whom ULC flaps had been used during the operation were identified. Written informed consent was obtained from the participants. The participants did not receive financial compensation. The ethics committee of the Ear, Nose, Throat-Head and Neck Research Center of Iran University of Medical Sciences approved the study. Data analysis was conducted from March 3 to May 10, 2014.

Exclusion Criteria

To eliminate confounding reasons for any irregularity of the dorsum, we excluded patients who had a history of any previous nasal surgery as well as those who had any history of na-

sal trauma after the operation. Of 41 patients identified, 3 could not be monitored for 1 year and therefore were excluded.

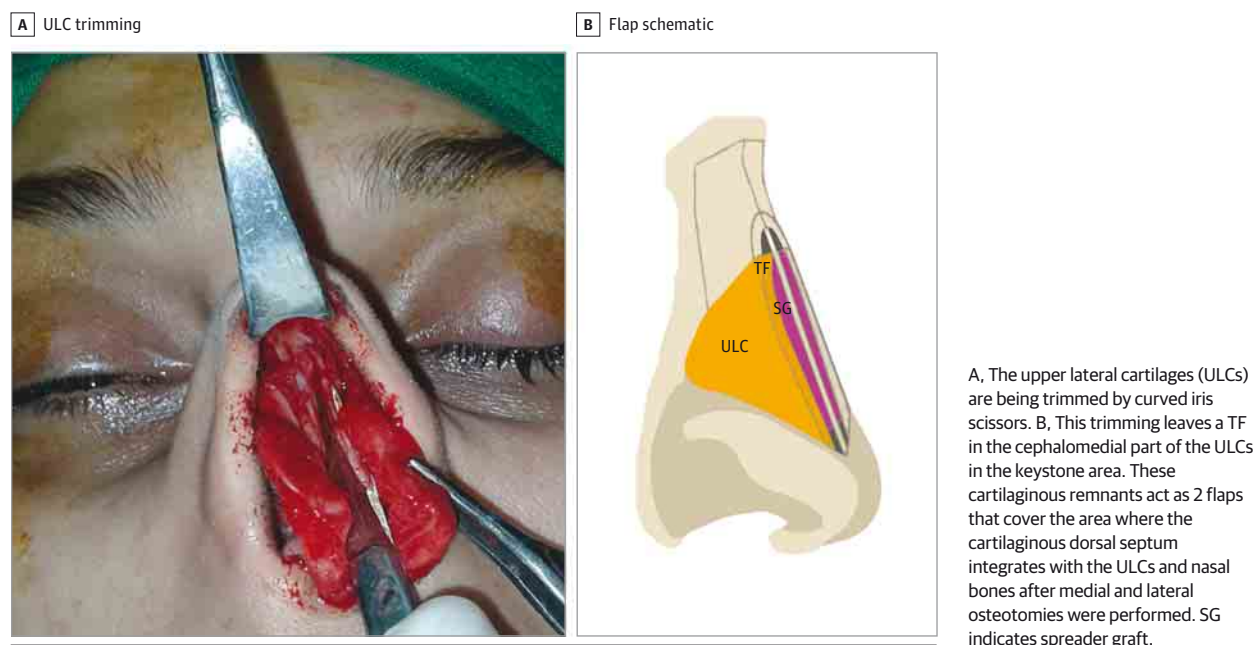
Included Patient Data

A total of 38 patients were included in the analysis. Using the patients' medical records, demographic characteristics, including age and sex, were gathered. Comparing preoperative and postoperative profile-view photographs of the patient, the amount of hump reduction was evaluated at the highest point of the nasal dorsum. The last postoperative profile views of the patients were reviewed separately by two of us (M.S. and M.J.), and any depression in the keystone area was noted. The medical records were assessed for any mentioned irregularity in the keystone area on physical examination (palpation) of the patients. The study was conducted in a research center; the operations were performed in a private setting.

Surgical Details

Patients had been scheduled for septorhinoplasty with flap reconstruction if more than 3 mm of dorsal reduction was planned after a precise analysis of preoperative profile views and if their skin was not thin. Meticulous skeletonization was used to expose the osteocartilaginous dorsum while maintaining the plane of dissection intimate to the perichondrium of cartilaginous dorsum. This dissection was continued subperiosteally over the bony dorsum.⁸ The hump removal was done using a No. 11 scalpel, starting with the cartilaginous dorsum and continuing with a Rubin 14- or 16-mm osteotome at a level 1.0 to 1.5 mm higher than the previously planned desired height. This maneuver led to the separation of the ULCs from the cartilaginous septum. The remaining 1 mm of septum was trimmed separately, and the bony dorsum was lowered by fine rasping. Finally, with the use of curved iris scissors, the ULCs were trimmed to the same height as the septum except at the cephalomedial parts where 1 mm of the ULCs were kept intact (**Figure 1**). This maneuver left a triangular-shaped ULC over the keystone area on each side. These flaps covered the keystone area after medial and lateral osteotomies had been performed. The next steps were inserting the spreader grafts and suturing them to the septum and ULCs, performing tip plasty, and suturing the caudal ends of the ULCs to the septum. For all of the cases, bilateral internal medial and lateral osteotomies with medial movement of the nasal bones (to close the open roof that was created after more than 3-mm hump removal) was performed. In some cases with a very wide nasal pyramid, intermediate osteotomies were also performed. The osteotomies are done as the last steps of the operation. It is important to perform final trimming of the triangular remnant of ULCs after the spreader grafts have been sutured and the osteotomies have been carried out because there may be a subtle change in the position of these flaps. At the end of the operation, the first tape was placed over the keystone area to control the position of the triangular flaps and push them medially toward each other in their correct position to reconstruct the integrated cartilaginous arch. The second tape was placed cephalic to, and the third one caudal to, the first tape. Taping and splinting were continued as routine. No anti-inflammatory injection was used.

Figure 1. Triangular-Shaped Cartilage Flap (TF)



Statistical Analysis

Descriptive statistics are presented as mean (SD) for quantitative variables. Analysis was conducted using SPSS, version 22.0 (IBM Corp).

Results

A total of 38 open septorhinoplasties using triangular ULC flaps that were performed between April 1, 2012, and March 3, 2013, were included in the analysis. There were 13 males and 25 females ranging in age from 17 to 58 years, with a mean (SD) age of 27.4 (9.3) years. The mean follow-up time was 15.0 months (range, 12-23 months). All patients had a more than 3-mm hump reduction. There was no depression or bulging in the keystone area in the profile views of the patients or any report of palpable irregularity. None of the patients underwent revision surgery (Figure 2).

Discussion

Performing a perfect septorhinoplasty is a challenge even for the expert surgeon. The challenge becomes more obvious with the nasal dorsum, where even a subtle depression can have an effect on the final profile view of the patient. The components that influence the lateral profile view of the nose are the nasal bones, keystone area, nasal septum, ULCs, supratip area, and nasal tip.

Several reasons have been proposed to explain the mechanism of notching in the keystone area after septorhinoplasty. The keystone area has a complex anatomy. This area is a transitional zone where the thinner skin of the bony dorsum meets the thicker skin of the supratip area.⁴ The retraction of unsup-

ported skin in this area has been postulated as a factor to induce a depression in the rhinion.⁹ However, this is the place where the bony dorsum integrates with the cartilaginous dorsal septum and upper lateral cartilages.¹⁰ Because of the variable forces required and different instruments needed to correct these elements, this area is vulnerable to uncontrolled resection. The en bloc resection to correct the dorsal profile has been a common practice for many years, but asymmetries can occur in the dorsum during the en bloc resection and throughout the healing process thereafter.¹¹

The ULCs extend below the nasal bones between 2 and 15 mm. This extension means that the cartilaginous part of nasal dorsum, which provides the “dome shape” of the cartilaginous dorsum and is composed of the 2 ULCs that are being connected to each other and the nasal septum, does not end at the beginning of the bony dorsum. In fact, it continues under the bony dorsum; therefore, at the caudal end of the bony dorsum, there are 2 arches: a cartilaginous arch beneath a bony arch (Figure 3). When a considerable amount of dorsum is removed, it leads to 3 “open roofs” in the bony dorsum, keystone area, and cartilaginous dorsum. The natural dome shape of the bony part is reconstructed by medial and lateral osteotomies to close the open roof. In the cartilaginous dorsum, spreader grafts or flaps are used that, together with the thicker skin of this part of dorsum, reconstruct the natural dome shape look of the cartilaginous dorsum. However, in the keystone area, where a cartilaginous dome of ULCs is present, the skin is thin and unable to cover this open roof. In these cases, a 1-mm triangular flap of ULC is retained in each side (that almost connect in midline after medial and lateral osteotomies) to reconstruct this portion of the nasal dome.

The problem of keystone depression and an unpleasant dorsal profile after traditional en bloc resection of the dorsal hump have been mentioned in cases involving large noses.¹⁰

Figure 2. Preoperative and Postoperative Photographs of Patients Who Received Triangular Flaps of Upper Lateral Cartilages



There is no bulging or notching of the keystone area in the profile views.

To overcome this shortcoming, component dorsal hump reduction was described^{12,13} to perform a more gentle dorsal reduction while preserving the ULCs. Dayan and Greene¹ proposed that, after separating the ULCs from the septum and reducing the septum, it is better to leave the ULCs untouched, let the now-redundant dorsal portion of the ULCs drop, and then fix them to each other and the septum. Although this maneuver can help prevent unpredictable healing of an open-roof dorsum and no pollybeak deformity was seen in their series, it may not be as applicable when reducing large hump noses. Other authors¹⁴ also have stressed the key role of the ULCs on the function and aesthetics of the middle third of the nose, describing various methods of reconstruction of the dorsum using a variety of suturing techniques, spreader grafts, and flaps. These methods were meant to reestablish the association between the ULCs and nasal septum to prevent middle vault collapse and an inverted-V deformity. However, the keystone area is indeed the apex of the inverted-V deformity; although these techniques can prevent or correct the arms of the “V,” the apex needs to be addressed separately.⁹

Suturing the ULCs together and to the septum in the keystone area using a horizontal mattress suture has been described by Roostaeian et al.⁵ Manavbaşı et al¹⁵ described the use of the ULC extension, lifting the ULCs after detaching their cephalic parts from the nasal bones only in the area of the bone to be removed and then swinging them together with a bridging suture to reinforce the keystone area. Folding of this part of the ULCs in the keystone area has also been described.^{6,16}

Our method combines the advantages of both techniques of dorsal resection: en bloc and component. Although en bloc resection is easy and fast, it is obvious that component reduction has the advantage of maximizing accuracy and control. The stepwise reduction of the ULCs makes it possible to maintain just a triangle of the most cephalomedial part of the ULCs and alleviate the need for dissecting the ULCs from beneath the nasal bones. We also did not suture the ULC triangles together, which alleviates a time-consuming, rather difficult step. Another benefit of this technique is the use of an autologous material in the form of flaps instead of grafts.

The common problems with onlay grafts are edge visibility, the risk of malplacement or displacement, resorption, in-

Figure 3. The Cartilaginous Dome Beneath the Bony Dome



The photograph, taken after removal of the bony hump, shows the cartilaginous dome underneath.

fection, and extrusion. In our method, at the end of the operation, these remnants may not be located in their ideal position; therefore, in patients with less thick skin (Figure 4), there may be minor bulging. However, after taping, we push the remnants toward each other to settle them into place. At the end of the operation and after removal of the nasal splint on the seventh day postoperatively, an integrated dorsum is palpable. The healing process with its neighboring anatomical components is enhanced as the *in vivo* anatomy is retained. Therefore, because these cartilaginous flaps remained undisturbed, the risk of unpredictable resorption or displacement is unlikely.

Upper lateral cartilages vary not only in dorsal (anterior-posterior) dimension but also in width (medial to lateral dimension), thickness, and resistance. Therefore, the size of these triangular flaps can be tailored to perfectly cover any defect in the keystone area that is created after hump removal. Because of this flexibility, although during trimming the ULCs we left 1-mm triangular shaped remnants of them, we were able to change the shape and size of the remnants as the last refinement of profile management. The use of this technique did not add any considerable time to the operation.

There are 2 considerations regarding the use of the technique presented here. First, we suggest the use of these flaps when the surgeon realizes that there is considerable space between the cephalic ends of the 2 ULCs (open roof in the key-

Figure 4. The Triangular Flap in a Patient With Thin Skin



The remaining triangular-shaped parts of the upper lateral cartilage (ULC) may be seen as a very slight bulging (arrowhead) at the keystone area at the end of the operation (before placement of the tape) in a patient with thin skin. This bulging is due to ULC resistance. However, on palpation, no ridge or bump should be noted; there should only be a fullness of the keystone area that is aligned with the bony and cartilaginous dorsum. Preserving the most cephalomedial part of the ULCs as 2 triangular flaps reaching the midline when more than 3 mm of hump is removed from a patient with normal skin can prevent keystone area notching by restoring the cartilaginous dome under the skin of this area.

stone area). We did not use this technique for cases in which less than 3 mm of dorsal nasal hump was removed or in revision cases. These flaps should not be felt on palpation as a ridge or bump at the end of surgery; rather, they should be felt only as a fullness of the keystone area that is aligned with the bony and cartilaginous dorsum. Second, although patients with thin skin are more prone to the notching of the keystone, none of our patients fit this category; thus, the skin had enough thickness to camouflage the cartilage flaps. Therefore, we recommend this method be considered with precaution in patients with very thin skin.

Conclusions

The triangular-shaped ULC flap provides a simple, fast, and practical means to prevent keystone notching in patients with large noses and normal skin thickness who have undergone hump reduction in primary septorhinoplasty. When used with other methods of stabilizing the ULCs, this technique is capable of creating a smooth, integrated nasal dorsum that endures.

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Study concept and design: Sharafi, Jalessi.
Acquisition, analysis, or interpretation of data: All authors.

Drafting of the manuscript: Jalessi.

Critical revision of the manuscript for important intellectual content: All authors.

Statistical analysis: Sharafi, Jalessi.

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